

Section 2

Data Evaluation

This HHRA evaluates potential current and foreseeable future risks to people who may recreate on or live near the Kalamazoo River and its floodplain. The range of possible exposures to river water, sediment, biota, and floodplain soil were examined. For some types of exposure, a quantitative assessment of cancer risk and noncancer hazard was conducted. For other types of exposure, only a qualitative evaluation was conducted because previous investigations for a similar site found these exposures to not be associated with a significant risk, given similar or higher media concentrations.

This section evaluates available data collected on and near the API/PC/KR site and determines whether data are adequate for conducting a quantitative or qualitative risk assessment.

2.1 Data Evaluation

Samples have been collected from fish, turtle, sediment, and surface water from the Kalamazoo River since 1971. The majority of the data used in this HHRA were collected in 1993 and 1997 and were reported in various technical memoranda prepared by BB&L, including Draft Technical Memorandum 12 – Former Impoundment Sediment and Geochronological Dating Investigation; Draft Technical Memorandum 14 (and addenda) – Biota Investigation; and Draft Technical Memorandum 5 – Willow Boulevard/A-Site Operable Unit: Results of Air Investigation.

Exposures to fish, turtle, floodplain soil, sediment, surface water, air, and waterfowl were considered in this risk assessment. Based on a review of these exposures, one of the following determinations was made for each exposure scenario/pathway under consideration:

- Quantitative evaluation of the associated exposure is needed
- Qualitative evaluation of the associated exposures is sufficient
- Additional data are needed to adequately evaluate the associated exposure

2.1.1 Fish Data

Fish data were collected in 1993 and 1997 as part of the Biota Investigation (BB&L 1994e, 1998). Several species of fish were collected including smallmouth bass, golden redhorse, carp, and spotted and white suckers. These data have been summarized and discussed in *Ecological Risk Assessment for the Allied Paper, Inc./Portage Creek/Kalamazoo River Superfund Site* (CDM June 1999).

Two species, smallmouth bass and carp, were selected to represent a popular targeted sport fish and a bottom feeding fish in the human health assessment. The 1993 fish tissue data included skin-off fillet data for carp and skin-on fillet data for smallmouth bass. These data were used for the risk assessment calculations. *Guidance for Assessing*

Chemical Contaminant Data for Use in Fish Advisories (EPA 1995) recommends that samples be prepared in a manner that best represents the edible portions of fish prepared and consumed by anglers. Concentrations of PCBs detected in fish fillets are presented in Table 2-1 for each of the seven areas evaluated in this risk assessment. To aid in the evaluation of aquatic habitats and chemical exposure, the API/PC/KR site was divided into 12 Aquatic Biota Study Areas (ABSAs). Nine of these ABSAs were evaluated as exposure areas in the HHRA. A list of these ABSAs is presented on Table 2-2. ABSAs 1 and 2 are located upstream of known sources associated with the API/PC/KR site and serve as reference areas for PCB contamination in fish tissues.

Table 2-1 Smallmouth Bass and Carp Data, API/PC/KR Site

Area/Species	Total Aroclor			
	Frequency of Detection	Range of Detection (mg/kg)	Average Conc. (mg/kg)	Maximum Conc. (mg/kg)
ABSA 3, 4, 5 Combined				
Small Mouth Bass	44/44	0.09 - 3.9	0.95	3.9
Carp	44/44	1.1 - 17	5.7	17
ABSA 6				
Small Mouth Bass	11/11	0.27 - 3.7	0.99	3.7
Carp	11/11	1.1 - 8.0	3.4	8.0
ABSA 7				
Small Mouth Bass	11/11	0.39 - 3.7	1.5	3.7
Carp	11/11	0.71 - 6.4	2.7	6.4
ABSA 8				
Small Mouth Bass	11/11	0.74 - 4.2	1.9	4.2
Carp	11/11	1.3 - 9.6	4.6	9.6
ABSA 9				
Small Mouth Bass	11/11	0.23 - 5.8	3.3	5.8
Carp	21/21	0.099 - 6.5	1.8	6.5
ABSA 10				
Small Mouth Bass	11/11	1.1 - 2.4	1.9	2.4
Carp	11/11	1.9 - 17	7.6	9.1
ABSA 11				
Small Mouth Bass	21/22	0.13 - 4.3	0.54	8.3
Carp	22/22	0.36 - 17	4.9	17

ABSA: Aquatic Biota Study Area. See Table 2-2 for description of ABSAs.

Table 2-2 API/PC/KR Biological Study Areas

ABSA 3	Kalamazoo River from Morrow Dam to Mosel Ave., Kalamazoo Aquatic biota were collected just downstream of Morrow Dam.
ABSA 4	Kalamazoo River at Mosel Ave. to Hwy. 131 bridge. Aquatic biota were collected from the Kalamazoo River near Mosel Avenue.
ABSA 5	Kalamazoo River near Hwy 131 bridge to Plainwell Dam. Aquatic biota were collected from the Kalamazoo River upstream of Plainwell Dam. Includes TBSAs 8, 9, and 10.
ABSA 6	Kalamazoo River from Plainwell Dam to Otsego City Dam. Aquatic biota were collected from the Kalamazoo River upstream of Otsego City Dam. Includes TBSA 10.
ABSA 7	Kalamazoo River from Otsego City Dam to Otsego Dam. Aquatic biota were collected just upstream of Otsego Dam.
ABSA 8	Kalamazoo River from Otsego Dam to Trowbridge Dam. Aquatic biota were collected upstream of Trowbridge Dam. Includes TBSA 3 and 5.
ABSA 9	Kalamazoo River from Trowbridge Dam to Lake Allegan Dam. Aquatic biota were collected from Lake Allegan.
ABSA 10	Kalamazoo River from Lake Allegan Dam to Ottawa Marsh. Aquatic biota were collected downstream of Allegan Dam. Includes TBSA 1.

Table 2-2 API/PC/KR Biological Study Areas

ABSA 11	Kalamazoo River from Ottawa Marsh to US 31. Aquatic biota were collected near Saugatuck.
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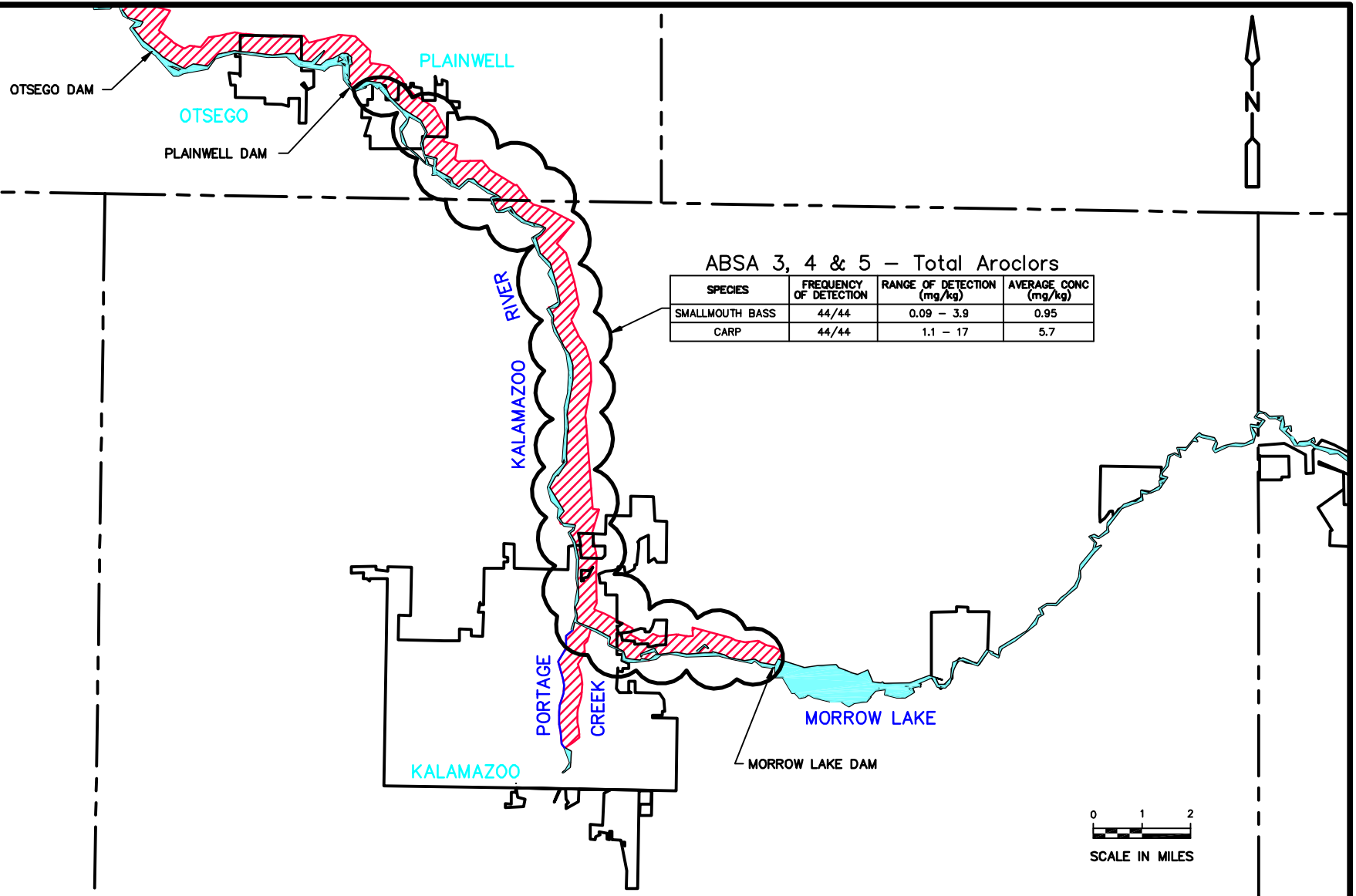
Note: ABSAs 1 and 2 are located upstream of Morrow Dam.

Three ABSAs, 3, 4, and 5, cover the area between Morrow Dam and Plainwell Dam. Data from these three ABSAs were combined for purposes of this assessment because it is assumed that fish can migrate within these areas, but due to the presence of the dams, will not migrate to adjacent ABSAs (i.e., ABSAs 2 and 6). After combining ABSAs 3, 4, and 5, all data sets represent a stretch of the river between two dams. Figures 2-1 through 2-4 illustrate fish data collected from the nine HHRA study areas.

Between 11 and 22 fish fillet samples for each species (smallmouth bass and carp) were collected for each ABSA. Quality control data is presented in Draft Technical Memorandum 14 – Biota Investigation (BB&L 1994) and generally conforms to the data quality objectives established for the site. For these reasons, fish data sets were considered adequate for risk assessment purposes. Because fish ingestion is the primary exposure pathway of concern for this site, this pathway was evaluated quantitatively. Risks and hazards were calculated using both average and maximum tissue concentrations.

2.1.2 Turtle Data

Taking of snapping turtles for consumption is known to occur in the vicinity of the site. While not well documented, the quantities of turtles ingested by individuals are believed to be less than the quantities of fish ingested. Representative data for PCB concentrations in turtle tissue are not available. Eleven turtle samples were collected from ABSAs 5 and 10. Detected concentrations of PCBs in turtles were reported in the Biota Investigation. Aroclor 1260 was detected in 11 out of 11 samples from ABSA 5, and 9 out of 11 samples from ABSA 10. Aroclor 1254 was detected one time in a sample from ABSA 10 at 0.53 mg/kg. Concentrations of Aroclor 1260 ranged from 0.021 to 0.49 mg/kg at ABSA 1 (reference area), 0.23 to 1.9 mg/kg at ABSA 5, and 0.11 to 8.1 mg/kg at ABSA 10. Turtles were collected from May 16 through May 21, 1994. Because samples were collected in the spring, lipid levels would likely be at their lowest. Similarly, concentrations of PCBs, which accumulate in fatty tissue, would also be lower at this time of year. Turtle samples collected later in the summer or fall would likely exhibit higher lipid levels and, possibly, higher PCB levels. Available data may under-represent PCB concentrations to which people ingesting turtles caught later in the summer and fall would be exposed.



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 KALAMAZOO RIVER HUMAN HEALTH RISK ASSESSMENT
 ABSA 3, 4 & 5

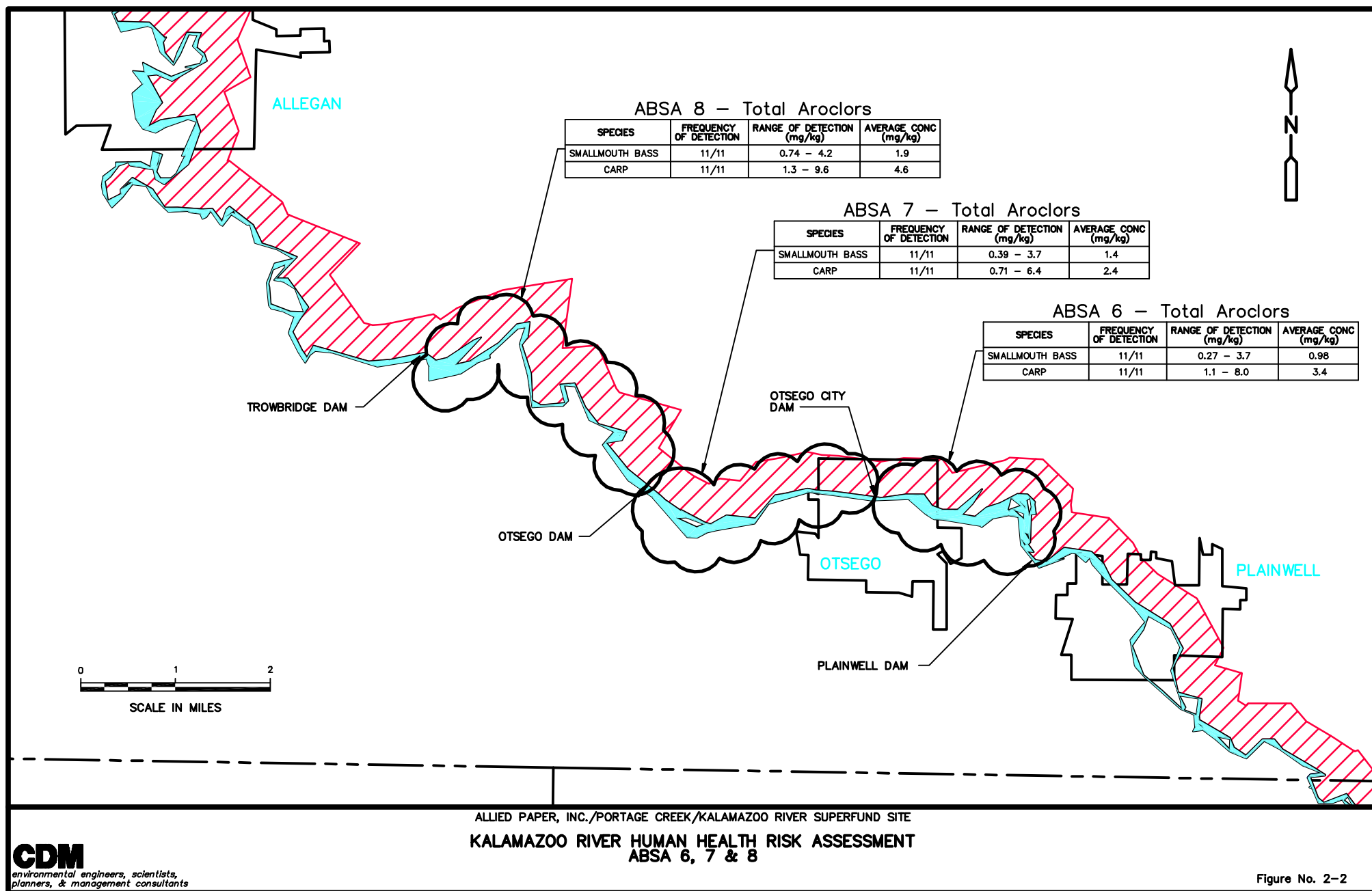
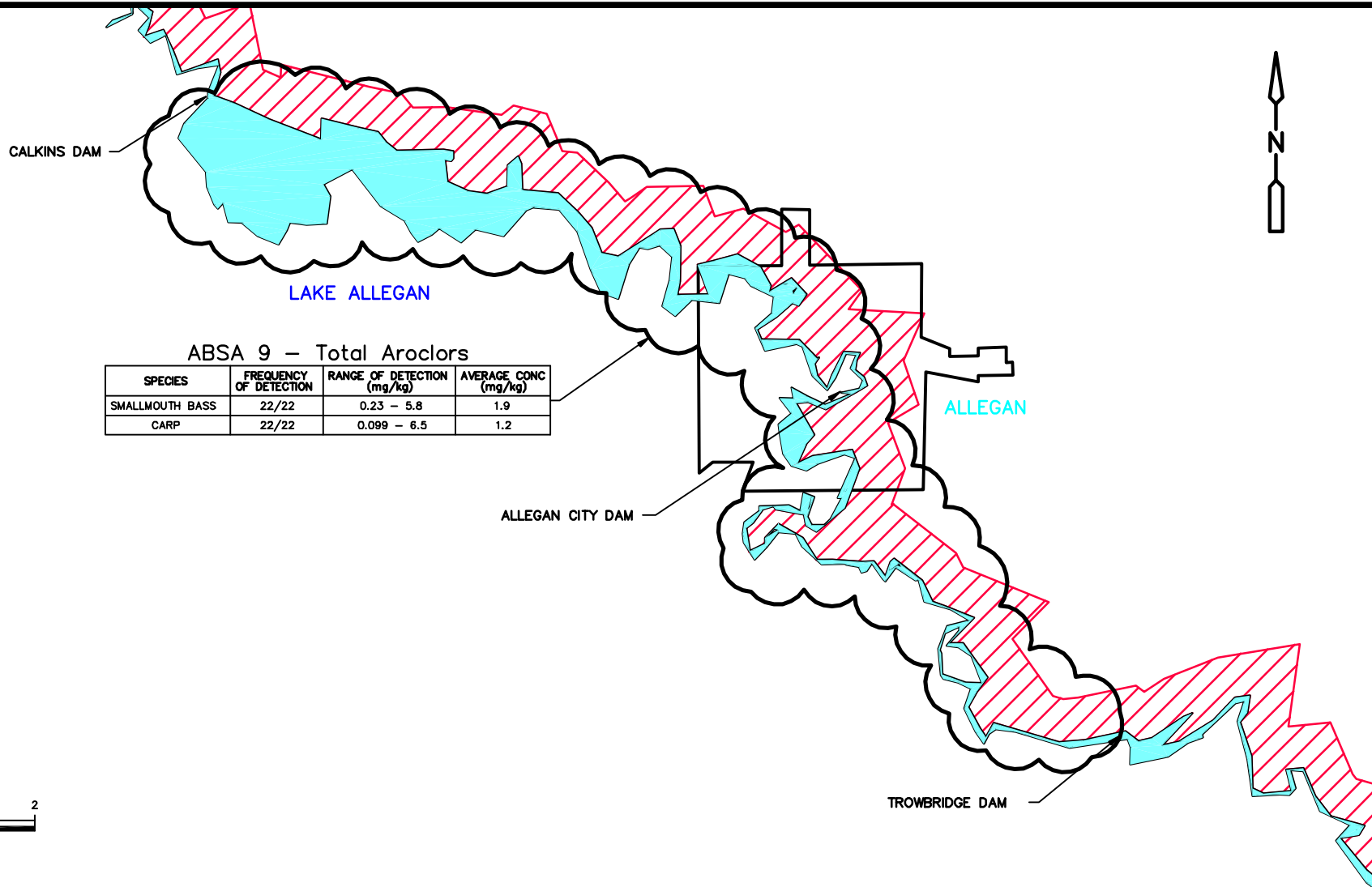
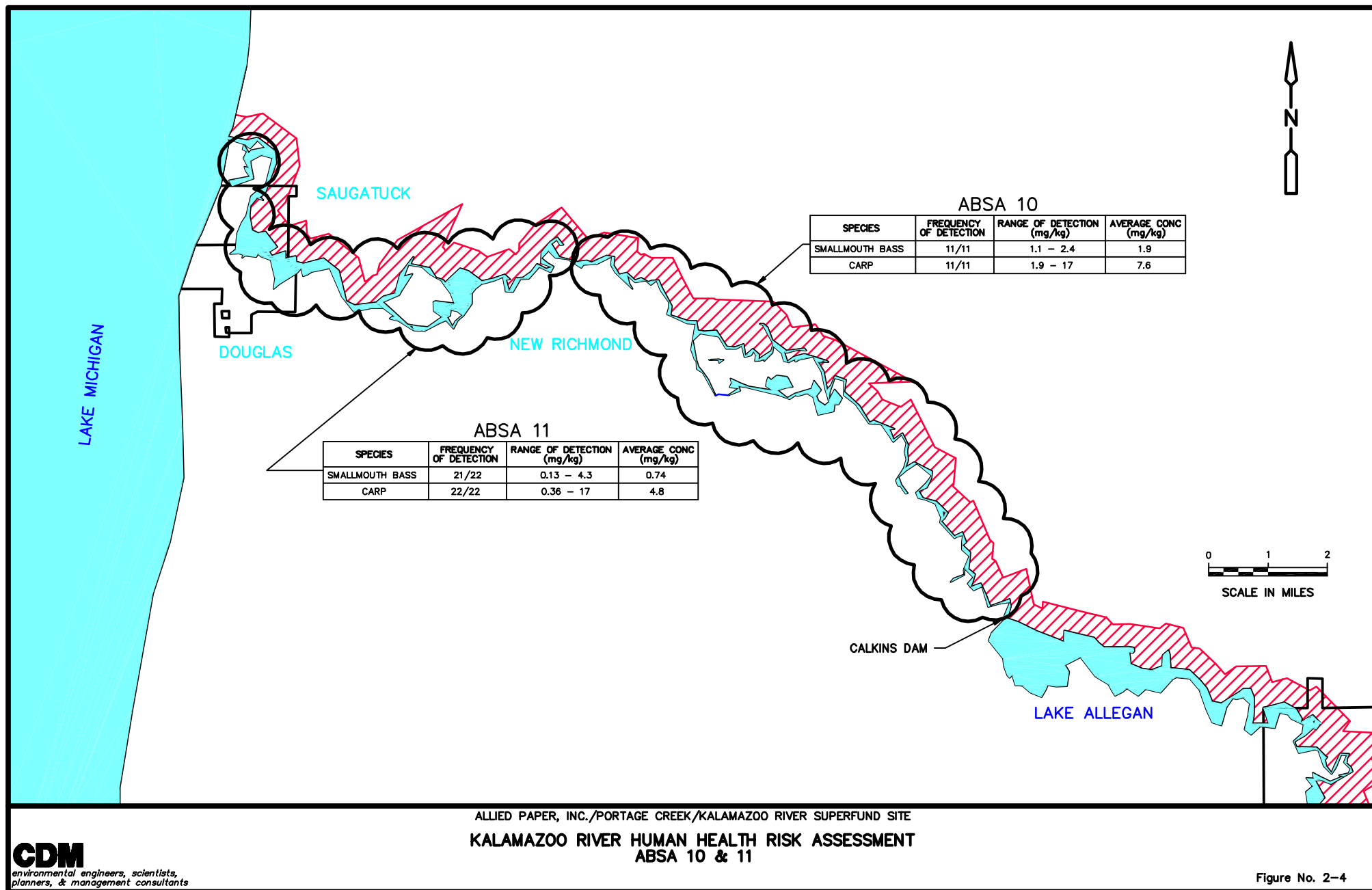


Figure No. 2-2



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KALAMAZOO RIVER HUMAN HEALTH RISK ASSESSMENT
ABSA 9



While PCB concentrations in turtles caught later in the season may be higher, detected PCB concentrations in turtles were generally less than those detected in fish. For example, total PCBs ranged from 0.13 to 5.8 mg/kg in smallmouth bass fillets and 0.1 to 17.2 mg/kg in carp fillets compared to 0.11 to 8.1 mg/kg in turtle tissue. Further, turtle ingestion rates are assumed to be less than fish ingestion rates, therefore, risks associated with turtle ingestion are likely to be less than those associated with fish ingestion. Lack of representative turtle data represents a data deficiency that could result in the underestimation of risks and hazards, and prevents defensible quantification of possible human health impacts.

2.1.3 Waterfowl

A limited number of waterfowl samples have been collected from the Kalamazoo River. In 1985, the U.S. Fish and Wildlife Service (USFW) collected 12 mallards, 2 wood duck, 1 Canada goose, and 1 blue-winged teal from Otsego City Impoundment, Trowbridge Impoundment, Allegan State Game area, and Saugatuck. Samples were analyzed for Aroclor 1260. These data are reported in Kalamazoo River Action Plan (Michigan Department of Natural Resources [MDNR] 1987). Detected concentrations ranged from 0.60 mg/kg in an immature mallard from Saugatuck to 4.8 mg/kg in an adult mallard from Otsego City Impoundment. Also in 1985, the USFW collected 2 mallards from the Kalamazoo River and 9 mallards from the Potawatomie Marsh. Samples were analyzed for total PCBs, which were detected in one sample at a concentration of 0.29 mg/kg. These data sets are included in Appendix C.

Based on the age of these data sets and their limited nature, these data cannot support defensible estimates of risks or hazards to hunters. This exposure pathway is, however, considered important for the Kalamazoo River area, since hunting waterfowl is a widespread recreational activity. Additional data are needed to adequately evaluate risks to this population. This pathway may be evaluated in an addendum to this HHRA.

2.1.4 Floodplain Soil/Sediment

The Kalamazoo River has been dammed in five places within the API/PC/KR. From the 1950s through the 1970s the paper companies discharged PCB contaminated effluent to the Kalamazoo River. Impoundments created by these dams acted as settling basins for PCB wastes. Three of these dams, Plainwell, Otsego, and Trowbridge, and their impoundments, were acquired by the state of Michigan in the late 1960s. The impoundments were drained in the early 1970s although the dams were not completely removed, thereby exposing sediments previously overlain by river water. These exposed sediments are part of the API/PC/KR site.

The exposed floodplain soils in the vicinity of the former Plainwell, Otsego, and Trowbridge dams cover approximately 61, 37, and 346 acres, respectively. Data from samples obtained from the top 0 to 6 inches soils were evaluated in this HHRA, because this horizon is most accessible to people living nearby. Table 2-3 summarizes

floodplain data for these three areas. Figure 2-5 illustrates areas of exposed floodplain soils. The highest PCB concentrations were detected in the Plainwell area, followed by Trowbridge and Otsego. The frequency of detection was above 80 percent for all areas indicating that deposition of contamination was widespread. Due to the proximity of residential areas to these areas of exposed sediment, exposures associated with floodplain sediment/soil are quantitatively evaluated in the HHRA.

Table 2-3 Floodplain Soil Data, API/PC/KR Site

Area	Total Aroclor			
	Frequency of Detection	Range of Detection (mg/kg)	Average Conc. (mg/kg)	Maximum Conc. (mg/kg)
Plainwell	33/42	0.027 - 85	10.9	85
Otsego	29/41	0.048 - 36	8.4	36
Trowbridge	60/76	0.051 - 81	12	81

2.1.5 River Sediment

Over 1,000 instream cores have been collected from 151 transects in the Kalamazoo River. Five to nine samples were collected from each transect and 365 samples were analyzed for PCBs, total organic carbon, grain size, and percent solids. These data were collected as part of the Remedial Investigation and were reported in Draft Technical Memorandum 10 – Sediment Characterization/Geostatistical Pilot Study (BB&L 1994a). Note that to date not all sediment cores have been analyzed. Sediment data used in this assessment were those available at the time the report was prepared.

The major potential exposure pathway associated with near and in-stream sediments is indirect, involving first uptake of PCBs into fish, then consumption of these contaminated fish by anglers. Since adequate fish tissue data were available for use in the HHRA, no modeling of transport of PCB in the food chain was necessary for the assessment of risks or hazards for this pathway. Sediment data were, however, used along with data from fish tissues, to estimate Biota Sediment Accumulation Factors (BSAFs). These factors were critical to the development of possible risk-based remediation goals based on fish consumption.

Based on an evaluation prepared by the Michigan Department of Community Health (MDCH), and a review of data and risks associated with sediment exposures at the Lower Fox River site, direct contact exposure to instream sediments during recreational activities is not an important means of exposure to PCBs. The Health Consultation for Allied Paper/Portage Creek/Kalamazoo River (MDCH 1997), prepared under a cooperative agreement with the Agency for Toxic Substances and Disease Registry (ATSDR) (July 2, 1997), notes that "moist sediments might adhere more strongly to skin than drier soil, but river water would tend to wash the sediments off before the soiled skin reaches the mouth or food." Further, the report concludes that "based on the PCB concentrations reported in the sediment and water of the Kalamazoo River, and considering the frequency of exposure to the sediments, and limited absorption of PCBs from soils, there is no need to restrict access to the sediment and water of the Kalamazoo River."

ALLEGAN CITY DAM

ALLEGAN

TROWBRIDGE DAM

OTSEGO CITY DAM

OTSEGO DAM

OTSEGO

PLAINWELL DAM

PLAINWELL

RIVER

KALAMAZOO

FLOODPLAIN SEDIMENTS FORMER IMPOUNDMENTS Total Aroclors

Areas	Frequency of Detection	Range of Dection (mg/kg)	Average Conc (mg/kg)
PLAINWELL	33/42	0.027 - 85	10.9
OTSEGO	29/41	0.048 - 36	8.4
TROWBRIDGE	60/76	0.051 - 81	12.3



SCALE IN MILES

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KALAMAZOO RIVER HUMAN HEALTH RISK ASSESSMENT FLOODPLAIN SEDIMENTS

These considerations indicated that exposure to instream sediments is not considered an important exposure pathway. Such exposures are not further evaluated in this HHRA.

2.1.6 Surface Water

Surface water concentrations of PCBs have been reported in Draft Technical Memorandum 16 – Surface Water Investigation (BB&L 1995a) and the description of the Current Situation (BB&L 1992). Maximum and central tendency (median) PCB concentrations reported in surface water in the most recent of these reports are 0.000071 µg/L and 0.000025 µg/L, respectively. All detected concentrations are below drinking water maximum contaminant levels (MCLs) published by EPA. The MCL for PCBs is 0.5 micrograms per liter (µg/L). The Kalamazoo River is not used for drinking water, but incidental ingestion could occur during swimming, wading, or similar activities. The quantity of water consumed during swimming (50 milliliters/hour, which is a typical swimming event) is estimated to be much less than that consumed when water is used for drinking (2 liters/day) (EPA 1989). MDEQ has established a surface water criterion for PCBs of 0.00012-µg/L protective of wildlife and a criterion of 0.000026-µg/L protective of human health. Water concentrations detected in the Kalamazoo have exceeded the criterion protective of human health; however, exposures via direct contact and incidental ingestion of surface water are not considered significant pathways and were not further evaluated in this HHRA. Further rationale for elimination of these pathways is presented in Section 3.2.

2.1.7 Air

No air data have been collected in the immediate vicinity of the River or exposed floodplain soils. An air investigation was conducted at the Willow Boulevard/A-Site Operable Unit (OU) located in Kalamazoo Township, Michigan. As reported in Draft Technical Memorandum 5 – Willow Boulevard/A-Site Operable Unit¹: Results of the Air Investigation, the air investigation involved collection of 15 samples over a 3-month period from 5 perimeter samplers and 2 background location samplers. Objectives of the air investigation were to (1) identify the highest representative PCB concentrations expected for adjacent or nearest public access and residential locations, and (2) provide data necessary to determine whether significant quantities of PCBs are migrating from the operable unit via the air pathway.

Sampling of both particulate phase and vapor phase PCBs according to standard EPA protocols was conducted using glass-fiber filters and high-volume polyurethane foam (PUF) cartridges, respectively. Arithmetic average concentrations of PCBs ranged from 0.00049 µg/m³ to 0.0029 µg/m³; this range is below the secondary risk screening level of 0.02 µg/m³ developed by the MDEQ Air Quality Division. At the time of sampling, the Willow Boulevard/A-Site OU was partially vegetated. Conditions have

¹ This OU is the site of two locations where PCB-containing wastes were placed adjacent to the river and within the floodplain.

since changed and the site is no longer vegetated but is covered with a temporary soil cover.

These data are not appropriate for evaluating risks and hazards associated with exposures to particulates or volatile emissions from the river or exposed floodplain soils. Instead of using site data, quantitative estimates of particulate and volatile emission from the exposed floodplain soil were developed using algorithms adapted from Standard Guide for Risk-Based Corrective Action Applied at Petroleum Release Sites (ASTM 1995). Exposures to PCBs in air based on these estimates are used in quantitative risk estimates for both residential and recreational exposure scenarios. Exposures to volatile emissions from surface water have not been evaluated. In the absence of air data or air modeling to characterize this exposure pathway, overall site risks are likely to be underestimated.